Advanced Power Wheelchair Applications

Michelle L. Lange, OTR, ABDA, ATP/SMS

ISS 2013

Agenda

8:00 – 10:00	Access Methods
10:00 – 10:15	*Break*
10:15 – 11:00	Hands-on time with access methods
11:00 – Noon	Programming
Noon – 1:00	*Lunch*
1:00 – 2:00	Exhibit Hall Programming various wheelchairs and driving
2:00 – 2:45	Interfacing (with demo)
2:45 – 3:30	IR Transmission (with demo)
3:30 – 3:45	*Break*
3:45 – 4:30	Mouse Emulation (with demo)
4:30 – 5:00	Emerging Technologies
5:00 – 5:30	Q & A, wrap up
5:30	Adjourn

Advanced Power Wheelchair Applications

Michelle L. Lange, OTR, ABDA, ATP/SMS

Introductions

- Who are you?
  - goals
- Who am I?

What we will be covering:

- Access Methods
- Programming
- Interfacing
- IR Transmission
- Mouse Emulation
- Emerging Technologies

Disclaimer!

- This is an advanced course, we are jumping right in, hang on tight!
- Ask questions, make comments, we are in this together!
- Take full advantage of hands-on opportunities

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Proportional

Digital

THE ACCESS METHODS

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Access Methods: Proportional

- Also called Analog
- Joysticks
  - hand
  - chin
  - head
  - forearm
  - foot
- handle types

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Joystick - hand

- Proportional joystick control requires grading of force and distance of movement
- Grading requires co-contraction of the flexors and extensors
- Difficult for clients with abnormal muscle tone

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Compact Joystick

- Compact Joystick Single Switch
- Textured for easier grasp
- Top is non-removable
- One switch on top of joystick acts as a Reset

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Compact Joystick

- Compact Joystick Dual Switch
- Two switches on top of joystick send signals thru 2 switch jacks
  - Reset
  - Tilt
  - Power
  - Mouse clicks
  - 1-2 switch SGD access

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Compact Joysticks

- Who would you use these with?

Tough Joystick

- Switched joystick
- 4 or 8 directions
- Heavy Duty to withstand significant forces
  - Significant force may mean decreased control

Switch-It!

Touch Pad

- Cellphone touchscreen technology
- Absolute Mode
  - Simple touch
- Relative Mode
  - Drag
- Built-in mode switch on screen
- Half screen mode
  - Reduces range required

Switch It!
Touch
Drive 2

Touch Pad

- Large surface
- Can accommodate fist
- Durable

HMC tablet control

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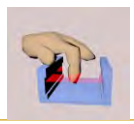
Touchless Finger Joystick

- HMC
- Proportional Control
- Fiberoptic Light
- Accommodates limited

Strength and active range



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Chin Joystick

- Can be mounted on a swing away arm or bib
- Can lead to repetitive stress injuries of the jaw or cervical area
- Can be difficult to use if surface isn't smooth

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Chin Joystick – Mounting

- Aluminum collar

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Chin Joystick – Mounting

- Collar mount or bib

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Chin Joystick – Mounting

- Swing-away bar

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Proportional Mini Joystick

- Less than 10g force

HMC

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HMC Joystick: Mounting

HMC

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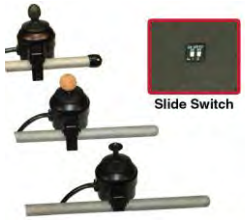
Mini Proportional Joystick

- Micro Extremity Control (MEC)
- Slide switch makes Reverse Reset
- Pushing down also acts as Reset
- 18 grams of force
- New version has shorter throw and a lighter spring



MEC

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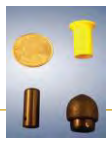
MEC Joystick - Mounting

Mini Proportional Joystick

- Switch It! MicroPilot
- Isometric joystick
- Requires very little throw
- Relies on force instead, approximately 10 -50 grams



MicroPilot - Mounting

Mini Proportional Joystick

- ASL Micro Mini Joystick
- Isometric joystick
- Mounted in a tray or contained in a box 1" square and ½" high

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Mini Proportional Joystick

- ASL Touch Point Joystick
- Proportional switch control
- More pressure increases speed
- Switches are diameter of pencil eraser
- Can be placed in any configuration
- Can also use as non-proportional

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Mini Proportional Joysticks

- Clinical Indicators:
  - Requires small travel distance
  - Requires minimal force to move and sustain joystick
  - Can be fragile
  - MEC includes reset (push downward)

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Mini Proportional Joysticks

- Who would you use these with?

ASL or Switch It! Playstation Drive Control

- No joke!
- Controls power wheelchair, seat functions and mode changes

Switch-It!

Playstation Drive Control

- Client can hold close in to body
- Light touch buttons
- Built-in mini joysticks
- Durable!
- Cannot assign buttons in the field
- Great for clients with Duchennes

Mushroom Joystick

- Designed for clients who cannot grasp a joystick handle
- Stiff
- Alternative:
  - Bodypoint dome handle
  - Textured

Stealth

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Foot Control

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- Proportional foot control
- Attaches to compact joystick

Switch It

HMC

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Arm Control

- Switch It! proportional arm control
- Attaches to compact joystick

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Arm or Foot Controlled Joysticks

- Who would you use these with?

Proportional Head Control

- Pushing back moves wheelchair forward
- Sustained pressure required to continue movement
  - Can lead to increased muscle tone and difficulty stopping

ASL

Switch-It!

Magitek Drive Control

- Sensor mounted at top of head
- Translates head movement into wheelchair movement
- Requires very good head control
- Stop: enter Neutral Zone
- Who would you use this with?

Joystick Handles

- Larger handles may reduce muscle tone
- Goal post style designed for poor grasp

Handle with Switch

- Joystick Extension Fifth switch
- Switch built-in
  - Can operate reset, mouse click, tilt, etc.
  - Mono jack

ASL

Questions?

Digital Access Methods

- Non-Proportional
- Switch

Digital Access Methods

- Single switch scanning
- 2, 3, 4 or 5 switch combination
- Sip ‘n puff
- Head Array (proximity)
- 4 switch proximity array
- 2 or 4 switch fiberoptic array
- Analog Digital Drive system
- Sip ‘n puff head array
- Roll Talk
- Tongue Drive

Switch Driving

- 1 switch: scanning
- 2 switch: Forward, Left, Right and Reverse and Reset
- 3 switch: Forward, Left, Right
- 4 switch: Forward, Left, Right and Reverse or Reset
- 5 switch: Forward, Left, Right, Reverse and Reset

Single Switch Scanning

- Clinical Indicators:
  - only 1-2 switch sites can be found
  - Client can see and monitor display

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Single Switch Scanning

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Single Switch Programming

- 4 or 8 direction
- Scan pattern
- Scanning “Mode”
- External scanner or on display

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2 Switch Control

- Q-Logic
  - Switch 1:
    - 2 activations = Forward, 1 activation = Left, double click = mode
  - Switch 2:
    - 2 activations = Reverse, 1 activation = Right

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Any 2, 3, 4 or 5 switch combination

- Clinical Indicators:
  - Ideally, 3 switch sites provides Forward, Left and Right directional control
  - If a 4th switch can be identified, Reset provides the most function
- Requires a switch

interface box and switches

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AbleNet

Any 2, 3, 4 or 5 switch combination

- Any combination of individual switches

or

- Switch array

AbleNet

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Switch-It!

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3 Switch Driving – movie time!

AJ

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3 Switch Driving – movie time!

Landon

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An Interesting Combination

- 3 Switch Driving

Right Turns AbleNet Jellybean left medial knee

Forward Jellybean behind left upper arm

Left Turns AbleNet Spec on strap base

Faith

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Another example…

- Switch under the chin is not ideal, but it worked…
  - She opened her mouth for activation

AbleNet Jellybean and Spec switches

Amy

And one more…

- Alexi, TBI, hypersensitive hands
- Isolated control at lateral knees

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Switch Arrays

- Sip ‘n Puff
- Proximity arrays
- Fiberoptic arrays
- Combination arrays

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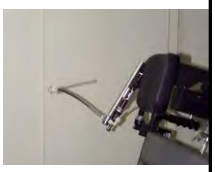
Sip 'n Puff

- Clinical Indicators:
  - Little control of head or extremity movement
  - Good oral motor control, lip closure, intact palate
  - Full directional control and speed control



Sip 'n Puff

- Mounting options:

Sip 'n Puff programming

- 4 pressure
  - Forward: hard puff
  - Right: soft puff
  - Reverse (or stop): hard sip
  - Left: soft sip
  - Latch
  - Speeds

Sip 'n Puff programming

- 2 or 4 pressure
  - 2 pressure on iQ and QLogic
  - Command Time/Sampling Delay
- 2 pressure
  - Between time
  - 2 puffs = Forward, 1 puff = Right
  - 2 sips = Reverse, 1 sip = Left

Sip 'n Puff stop switch

- Stops the wheelchair if the straw moves out of reach
- Can also be used as a reset switch
- Travis and Jessica

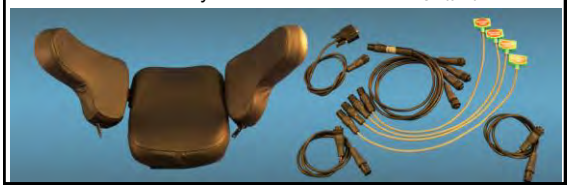
ASL

Switch-It!

Head Array (proximity switches)

- 3 -5 proximity switches in a tri-pad headrest
- Clinical Indicators:
  - Fair to good head control
  - Little extremity control

Switch-It!



Head Array with Beam Switch

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Stealth Head Array

- Suboccipital pad can increase stability of the head

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Permobil Head Array

- Total Control Head Array System
  - Can combine electrical and mechanical switches
  - 6 input jacks on back (1/8")
    - Mechanical mono
    - Electrical stereo

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Permobil Head Array

- Total Control Head Array System

Permobil Head Array

- Photo courtesy of Steve Mitchell
- Configured as Sip 'n Puff Head Array

Head Array – movie time!

Austin

Head Array – another movie

Taylor

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Proximity switch arrays

- Typically placed under a tray
- Consider tactile cue above (i.e. loop Velcro)
- Consider pigtail cable

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Switch–It!

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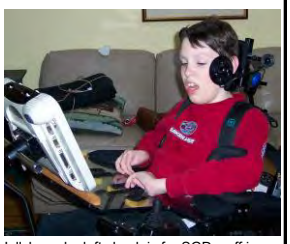
Proximity Array

- Clinical Indictors:
  - Fair upper extremity control
  - Accommodates larger movement
  - Eliminates a plane of movement

Mark



Jellybean by left cheek is for SGD, cuff is to keep left hand off of proximity switches and to provide stability. Right hand accesses proximities

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Proximity Array

- Mounting options

Clear vs. Solid tray: visual field

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Fiberoptic Switch Arrays

- Small targets
- Accommodates very small movements with no force
- Typically placed by finger or thumb
- Cables are fragile

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Switch-It!

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4 switch fiberoptic array in tray

- Can mount in tray on superior surface or side
- Can mount in armtrough, as well

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ASL 2 switch fiberoptic array

- Cover both beams for forward
- Cover left for left directional control
- cover right for right directional control
- 3rd switch can be used as reset
- Proportional version

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Fiberoptic Mounting Options

- Good location to capture tongue extension or cheek puff
- Good site for Reset

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Combining Electronic Switches

- Farid, age 8
- SMA, type I
- Driving with:
  - Forward: 1 fiberoptic switch under right index finger
  - Left: 1 fiberoptic switch under left index finger
  - Right: 1 proximity switch by left medial knee
  - Reset: 1 proximity switch by right medial knee
- Invacare MK6i, ASL

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Fiberoptic: Left

Fiberoptic: Forward

Proximities: Right and Reset

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Farid Driving

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Combination Systems

- Analog Digital Drive
- Sip ‘n Puff Head Array

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Analog Digital Drive System

- Left and Right pads active on the head array
- Forward and Reverse active on the joystick
- Why would you choose this?

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Sip 'n Puff Head Array

- Left and Right pads active on the head array
- Any puff is Forward
- Any sip is Reverse
- Who would you choose this for?

Stealth

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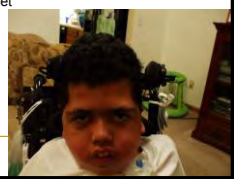
Combining Mechanical and Electronic Switches

- Julian
- SMA, type I

Microlite, right medial knee, Right

Fiberoptic, left thumb, Forward

Proximities at either side of head for Left and Reset



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Combining Mechanical and Electronic Switches

- Invacare and ASL
  - Julian can control Driving, Reverse, Tilt and Speed

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Eye Gaze

- Roll Talk
  - Allows driving with eye gaze
  - A single switch hit is still required to "wake up" system
  - Controls many other functions including communication and EADL functions
  - Primarily designed for clients with ALS

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Eye Gaze

- Roll Talk

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Tongue Control

- Only a bunch of college students would volunteer to pierce their tongue…
- Still in research at Georgia Institute of Technology
- Movement of tongue is translated into movement of the chair

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The Future

- Tongue Drive System
- Brain controlled
- Voice controlled
  - Actually available, but safety concerns
- Computer controlled

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A word about Tracking…

- Tracking technologies increase driving efficiency and really make a difference with alternative access. Driving efficiency is also impacted by drive wheel configuration

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A word about Tracking…

- Informal tracking study comparing midwheel drive PWC with and without tracking enabled:
  - 3 switches on a tray
    - 57% less switch hits
    - 38% less time
  - Head Array
    - 69% less switch hits
    - 47% less time

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Questions?

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Take A Break!

- Please come back in 15 minutes

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Hands-on Time!

- Split into groups
- Rotate through
- Hop in and drive!

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PROGRAMMING

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Programming

- Driving Parameters
- Proportional specific parameters
- Non-proportional specific parameters

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Why is this Important?

- Cathy

Why is this Important?

- Not programming a PWC for an individual is like not customizing an Ultralightweight MWC for optimal self-propulsion

Whose Job is This?

- Takes a team…

Programming Driving Parameters

- Driving parameters affect the speed and responsiveness of the PWC and are not access method specific
  - Can increase driving efficiency
  - Can customize to an individual's environmental needs
  - Can make a PWC downright dangerous!

Poll Time!

- Are you currently programming PWCs?
  - Yes
  - No
  - I want to!

Programming Driving Parameters

- Programming can often be done by changing overall parameters (typically speed and responsiveness) or individual parameters
- Overall programming automatically changes a number of specific driving parameters in proportional to one another

Programming Driving Parameters

- Programming choices
  - Simple
    - Speed and responsiveness
  - Advanced
    - Parameter by parameter
  - Invacare MK6i
    - Overall Speed and Performance

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Programming Driving Parameters

- Some Electronics packages offer preset programs to choose from
- You can customize from there
- Saves time and reduces chance of error

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Driving Parameters

- Programming choices
  - Invacare MK6i
    - Standard Programs
      - i.e. “very slow learner”
  - Q-Logic
    - Program for each device type
    - More on web
  - Make your own!
    - Did a program turn out really well? Save it to use with similar clients!

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Driving Parameters

- Speed
- Acceleration
- Deceleration
- Torque
- Remember, these parameters may look different using different access methods or drive wheelchair configurations

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Driving Parameters

- Remember, a specific parameter setting may respond differently using:
  - different access methods
  - different drive wheelchair configurations
  - Different electronics package

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Speed

- Maximum speed in a specific direction
  - Usually listed as a % of the full speed
- Forward
- Turns
  - Much lower than Forward
- Reverse
  - Lower than Forward
  - Drivers have less control rearward and may reverse farther than necessary if this is too high

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Speed

- Proportional access methods provide speed control
- Non-proportional access methods offer one speed only
- Drives or Profiles can be set up with different parameters
  - Allows different speeds for different circumstances

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Speed

- Generally slower for inside
- Faster for outside
  - Crossing the street before the light is red
  - Keep up with companions walking
    - Around 2 mph
  - Getting to class on time
  - Keeping up with peers on the playground
    - Around 200 mph!

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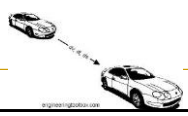
Acceleration

- How quickly the wheelchair achieves full speed in response to access method activation
- Too fast: chair may be jerky and throw the client rearward
  - Can lead to startle, anxiety
- Too slow: chair may be unresponsive



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Deceleration

- How quickly the wheelchair comes to a full stop in response to access method release
- Too fast: chair may jerk to a stop, pitching client forward, possibly rocking chair forward
- Too slow: chair will roll to a slow stop and may inadvertently run into walls, etc.

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Torque

- Like driving in low gear
- Increases power without increasing speed to drive on carpet, over thresholds, etc.
- Intuitive Torque
  - Increases torque at lower speeds automatically
  - Q-Logic

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Torque

- Turn down torque to prevent the following:
  - Chair climbing the wall
  - Chair moving the furniture
  - Chair punching holes in wall

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Proportional Specific Parameters

- Sensitivity
- Short throw
- Deadband
- Changing axes
- 3 direction
- Switch Joystick

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Sensitivity

- How quickly the PWC responds to joystick movement
- Sometimes referred to as Tremor Dampening
- Too High: PWC drives too perky
- Too Low: PWC is unresponsive
- Switching to a mini proportional joystick?
  - Sensitivity may have to be reduced

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A Sensitive Video

Thanks Maz!

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Short Throw

- Shorter distance is required to achieve full speed
- If a client with muscle weakness is struggling with a standard joystick, increasing sensitivity and enabling short throw can help
  - May consider mini proportional joystick
- Use with caution with mini joysticks

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Deadband

- Draws an imaginary line around the joystick
  - Driver must move past this boundary to initiate movement of the chair
- Designed for goalpost handles
- Available on Q-Logic and R-net

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Changing Axes

- Choose which joystick movement results in which directional movement
- i.e. Forward can be swapped with Reverse

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3 Direction

- 3 directions can emulate 4
- i.e. pulling back on the joystick can be Forward. Press Reset, now pulling back on the joystick controls Reverse.
  - MK6i: RIM mode
  - R-net: Training mode inhibits one drive
  - Q-Logic: 3-Direction Profile

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Switch Joystick

- Change a proportional joystick to a switch or non-proportional joystick
  - 4 directions
- Why?
  - May help a client who tends to veer
  - New drivers
- MK6i: in Latched only
- R-net: in step latched drive only
- Q-Logic: past 50% joystick deflection only

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Non-Proportional Specific Parameters

- Driving parameters effect performance differently with different access methods

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Single Switch Scanning

- Speed of scan
- Scanning mode
- Scan pattern
- 4 or 8 directions

Single Switch Scanning

- MK6i
  - requires external scanner
- R-net
  - 4 directions on display
  - Scans chair functions
- Q-Logic
  - 12 scanner options
  - Can disable mode option

If using with SGD

Switch Access Programming

- Q-Logic
  - 2 switch option
  - 3 switch option
    - Can program double hit on Left to access actuators
      - May avoid need for Reset switch

Sip n Puff

- 4 pressure
  - Calibrate Hard and Soft pneumatic commands
  - Ramping
    - R-net: ramp up, ramp down
    - Q-Logic: Sampling Delay
    - Allows client time to build pressure
    - i.e. Frank

Sip n Puff

- 2 pressure
  - Between Time
    - Time between double switch activation

Head Array

- How to access Reverse
  - Using a Reset or Mode switch to toggle Forward and Reverse

Head Array

- How to access Reverse
  - Standby
    - Choose Forward or Reverse
    - Invacare
      - Left command = Reverse
      - Forward command = Forward

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Head Array

- How to access Reverse
  - Rear Pad (R-net, Q-Logic)
    - First activation toggles Forward/Reverse
    - Second activation drives

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Other Useful Programming

- Sleep Mode
  - All functions are disabled until Mode switch is activated
  - Allows a client to rest (i.e. on Head Array) without any unexpected results

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Other Useful Programming

- No Driving Mode (MK6i)
  - Disables driving in a specific mode while all other functions are available
  - Why?
    - Mark and the big screen TV

Other Useful Programming

- Power Seating Functions
  - Acceleration
  - Deceleration
  - Speed
  - Distance
  - Combinations of movement
  - Pressure relief reminder
    - MK6i
    - Q-Logic

Questions?

Lunch Time!

- Lunch!
- Be back here by 1pm to get ready for more Hands-on Time!

Hands-on Time!

- Split into groups
- Grab your Programming Worksheet
- Go to the Exhibit Hall and have fun!
- Be back here by 2pm for Interfacing!

INTERFACING

Interfacing

- How to control an external assistive technology device through the drive control
  - Speech generating devices (SGDs)
  - External mouse emulators
  - External EADLs
- Pros
- Cons
- Components required
- Programming required

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Case Study

- Sally
  - Age: 8 years
  - Diagnosis: cerebral palsy
  - Driving a power wheelchair using a Head Array
  - Accessing her SGD using a left head switch

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Case Study

- Sally
  - Problem: Sally doesn't have another means to drive the wheelchair efficiently and has been accessing her SGD very well with a left head switch
  - Solution: Share the left head switch! "How?" Interface!
  - More in a bit…

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Advantages of Interfacing

1. Many technologies work together
2. Streamlines access for individuals with limited switch sites and control
3. Allows strong switch sites to be used for more than one function
4. Interfacing may be less expensive since additional access methods are not needed

PROS

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Disadvantages of Interfacing

1. If interfacing is too difficult and/or does not work well, people will shy away from it. It is challenging to find experts in this area.
2. The system is more interdependent
3. Back-up access methods required outside of power wheelchair
4. Interfacing adds to the cognitive load
   - memory and sequencing
5. Interfacing can be difficult visually or for those who do not read English
   - display

CONS

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Disadvantages of Interfacing

6. Interfacing may add to access requirements
   - if only 1 item is being interfaced, adding a reset switch may be no different than adding another control switch
   - the same switch may be used in a very different manner
     - sustained contact for driving, quick release
     - momentary contact for scanning, quick activation

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Disadvantages of Interfacing

7. Sharing an access method may compromise access efficiency
   - Interfaced method may not be optimal access method

Components Required

- Interfacing component
- Interfacing cable

Components Required

- Interfacing component
  - MK 6i: Aux1/2 or Aux3/4
  - R-net: Input/Output Module (IOM)
  - Q-Logic: ECU Module

Components Required

- Interfacing cable
  - Several manufacturers
  - Adaptive Switch Labs (ASL) 802 series

802-4

802-2 L/R

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How Does It Work?

- Consumer puts chair in an Auxiliary Mode to send a signal through the Interfacing Component
- Same as accessing power seating functions
- Some electronics require the auxiliary port to be activated with a programmer

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Interfacing Speech Generating Devices

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Interfacing Communication Devices

- Pros
  - streamlines access
  - shares a strong access method
  - SGD access method does not have to be moved to the power wheelchair

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Interfacing Speech Generating Devices

- Cons
  - May compromise access efficiency if shared switch cannot be accessed well for scanning
  - Cables required
  - Need to provide a back-up access method when not in power wheelchair
  - Do not use with Standby

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SGD Access Methods

- Direct
  - don't interface
- Scanning
  - single or dual switch
  - use cable with 1 or 2 switch jacks
- Joystick
  - 9 pin to 9 pin cable
- Mouse
  - mouse emulator required

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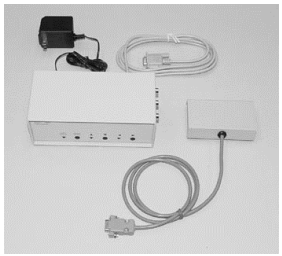
Mouse Emulator

ASL



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Interfacing Computers

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Interfacing Computers

- Pros
  - streamline access
  - newer mouse emulation options available
  - increased independence if assistance is not required to connect cables
    - laptop on wheelchair that is already connected
    - wireless options to transmit to desktop computer

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Interfacing Computers

- Cons
  - often more efficient access methods than interfacing through the power wheelchair access method
  - need to consider both keyboard and mouse emulation
  - need back-up access method for when client is not in power wheelchair
  - do not use with Standby
  - Client may require assistance to connect cables

Interfacing Computers

- Other Interface Options
  - many SGDs can be interfaced to a computer and used as an access method

Interfacing Computers

- Keyboard emulation
  - scanning on-screen keyboard
  - other scanning arrays
- Mouse emulation
  - mouse click
  - mouse emulation (built-in or external)

Interfacing Computers

- Switch Interface for
  - single switch input
    - single switch software
    - Onscreen scanning keyboard
  - mouse click

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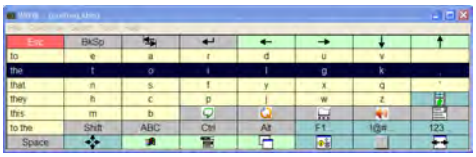
Interfacing Computers

- Scanning On-screen keyboards



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Interfacing Computers

- ASL Mouse Emulator
  - 3 switch for use with the Head Array
  - 5 switch for use with a joystick
  - USB
  - Wireless version
- Built-in Options
- We will discuss more about these later

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Interfacing Tablet Computers

- We will discuss this under Emerging Technologies

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Interfacing Electronic Aids to Daily Living

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Interfacing Electronic Aids to Daily Living

- Pros
  - Streamline access
- Cons
  - need back-up access method
  - needs to be portable
  - consider use from bed and chair
  - may compromise access efficiency
  - do not use with Standby

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Interfacing Electronic Aids to Daily Living

- Can use EADL that is accessed by switch scanning
- Can use with single function EADLs
  - Power door openers
  - Switch activated telephones

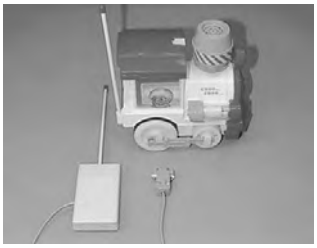
Interfacing Electronic Aids to Daily Living

- Other Interfacing Options
  - SGDs often have these features built-in
  - EADLs can also be controlled through a computer
  - Through the PWC

Interfacing More Than One Device

- Most Interfacing Components have 2 ports
- Some Interfacing Components can be connected to each other to provide 4 ports
- Use the interfacing cable
  - i.e. Forward sends a command to the SGD and Left sends a command to the door opener, but the cable only takes up one port

Interfacing Toys



Interfacing Toys

- Interface component
- Cable
- Switch adapted toy
  - hard wired
  - Remote
    - ASL option
    - Switch-It! option

Case Study: Sally

- Age: 8 years
- Diagnosis: cerebral palsy
- Driving a power wheelchair using a Head Array
- Accessing her SGD using a left head switch

Case Study: Sally

- Problem: Sally doesn't have another means to drive the wheelchair efficiently and has been accessing her SGD very well with the left head switch
- Can use a Reset switch by her left hand
- Solution: Interface! How?

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Case Study: Sally

- What components will be required?
  - Head Array
  - Mode switch
  - Interfacing component
  - Interfacing cable (ASL 802-1 L)

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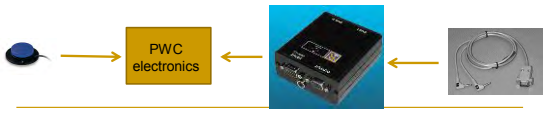
Case Study: Sally

- Connections
  - Mode switch plugs into display or main electronics
  - Interfacing component plugs into electronics
  - Interfacing cable plugs into a port on Interfacing Component (9 pin) and into SGD switch jack



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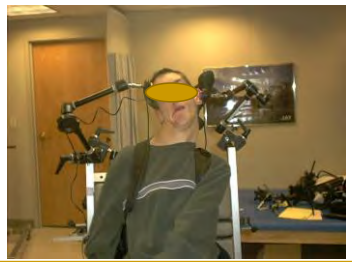
Case Study: Sally

- What programming will be required?
  - Turn on port 1 of Interfacing Component, if required
  - Choose transmission method, if required
    - *Momentary
    - Latched
    - *Communication
      - Allows for diagonal control
      - Speeds up transmission slightly

Let's Kick it Up a Notch!

- Paul
- Age: 25 years
- Diagnosis: cerebral palsy
- Driving a power wheelchair with left head switch and scanning
- Using left head switch for SGD

Case Study: Paul



Case Study: Paul

- Goals: better access method for driving, speed control, power tilt, access to SGD, access to computer, EADLs
- Problem: Paul only has one switch site and many features and devices to control

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Case Study: Paul

- Solution: 2 year solution!
- Evaluated for new access method to power wheelchair: 3 touch switches in a splint
- Evaluated for mode/reset switch location: left side of head

184

Case Study: Paul

- What components will be required?
  - Three touch switches in splint
  - Mode switch by left side of head
  - Interfacing component
  - ASL 802-2 (L/R) interfacing cable

185

Case Study: Paul

- Connections
  - Mode switch plugs into display or Interfacing Component
  - Interfacing Component connects to electronics
  - Interfacing cable plugs into port on Interfacing Component (9 pin) and into SGD switch jack (left was used until Paul fatigued, then he switched to right. He used a Y adaptor so he could switch independently)

186

Case Study: Paul

- What programming will be required?
  - Determine method to access Reverse
  - Determine method to access Speed
  - Determine method to get to actuator mode for control of power tilt. Choose directional switches to control tilt (L/R)
  - Enable Interfacing Component port, as needed
  - Choose Transmission speed, as needed

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How Did it Work?

- Drive Mode: switches in splint for Forward, Left, Right
- Reset: Forward toggles to Reverse
- Reset: Left and Right change Drives to change Speed
- Reset: Left and Right control Tilt Up and Tilt Down
- Reset: Left or Right send signals to SGD
- Reset: Drive Mode

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Questions?

Demonstration Time!

IR TRANSMISSION

Accessing EADL features through the Drive Control

- EADLs = Electronic Aids to Daily Living
- Built-in on Q-Logic and R-net
- Additional cost on Invacare
- Built-in = Free!!! No additional funding approval required

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Accessing EADL features through the Drive Control

- IR signals are sent from the display to control devices in the environment
  - Any device that receives IR, i.e. TV
  - Any X10 or Insteon controlled device (i.e. lights, appliances, thermostat) using an IR converter

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Pros and Cons

- Pros
  - Increased independence in the home
  - Streamlines access
  - Cost savings
- Cons
  - Complexity
  - Lack of access from bed
  - Switch access only

Invacare IR Emitter

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IR Transmission

- Infrared transmission are light signals, just like those used in your TV remote control
- Will not go through walls, ceilings or your dog
- Other light can interfere with signals
  - Florescent

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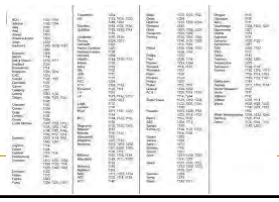
IR Transmission

- IR signals can be pre-stored or learned
  - Pre-stored: universal remotes
    - Eases programming
    - Can only control what is pre-stored
    - Newer devices may not be accommodated



IR Transmission

- IR signals can be pre-stored or learned
  - Learning
    - Can read, learn, store and transmit any IR signal
    - Tips:
      - Clean the "windows"
      - New batteries
      - Original remotes
      - Some devices need a longer IR signal
      - Beware of remotes that send more than IR

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What if it Doesn't Work?

- If the PWC cannot learn the required IR signals, it may be that the signal being sent is actually a radio signal.
  - PWC electronics and learning external EADLs cannot learn these signals and so these devices cannot currently be controlled via alternative access
  - This is often a problem with cable providers

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What if it Doesn't Work?

- Another option: using a wireless network
  - Many APPs are available to allow control of devices in the environment
  - Some are from Cable providers and take advantage of your in-home wireless network
  - Accessibility is a barrier: motor, visual, cognitive
  - Not available through a PWC
    - Though a Tablet can be accessed through the PWC

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Telephone

- Display sends IR signals, so can control an IR phone
  - expensive
- www.atilange.com, under Resources is a comparison of IR phones

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X-10 Control

- Allows on/off control of lights and appliances, also control of thermostats, electric beds, door openers and more
- Display only sends IR, so an X10/IR Converter is required, in addition to modules

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The IR/X10 Converter problem…

- The converter that has been used in the past for these applications has been discontinued
- Solution? Insteon!

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Insteon Module Control

- www.smarthome.com
- IRLinc Receiver #2411R
  - Receives IR signals and sends to modules
  - Includes remote
- Access Point #2443
  - Order 2, phase couplers that allow devices to talk across circuits

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Insteon Module Control

- ApplianceLinc #2456S3
  - Appliance module
- LampLinc #2456D3
  - Lamp module
- Thermostat #2491T1
  - Thermostat control
- Insteon Wall Switch #2477D
  - For ceiling lights

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IR Transmission

- Invacare Specifics
  - Can control 6 devices
    - I X10
  - Preset codes
  - Learning
  - No Macros
  - Can learn IR commands for Insteon control
  - Can learn IR commands for IR phone

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IR Transmission

- R-net specifics
  - Preset codes
  - Learning
  - Can learn IR commands for Insteon control
  - Can learn IR commands for IR phone

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IR Transmission

- Q-Logic specifics
  - No preset codes
  - Can learn up to 288 codes
  - Can learn macros (up to 3 commands)
  - 256 X-10 codes
  - Can learn IR commands for IR phone

(2/8 photo requested)

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Questions?

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Demonstration Time!

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Take A Break!

- Please come back in 15 minutes

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MOUSE EMULATION

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AT Access

- There are many ways to access a computer or Speech Generating Device
- Before looking at mouse emulation, make sure this is the optimal access method

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Mouse Emulation

- Transmission Method
- Cursor movement
- Clicks
- Keyboard Emulation

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Transmission Methods

- Infrared (IR): outdated, line of sight, interference
- Radio (RF): may be interference with other users
  - Includes ZigBee and Bluetooth
  - Bluetooth (BT): not always reliable, may need to be recharged

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Transmission Methods

- BT may be an issue if the client is using a computer and a SGD
  - BT mouse on PWC won't pair with more than one device at a time
    - Can set up 2 Invacare mouse emulators, one for each
- "Discovery" of the wheelchair BT mouse feature can be difficult, but once done, it usually sticks

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Transmission Methods

- PRC SGDs
  - Have to add BT dongle
  - Have to download software to make discoverable

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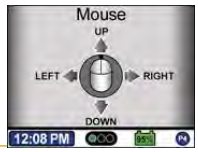
Transmission Method

- MK6i: Radio
  - Separate from display, retrofittable
- R-net: Blue Tooth
  - Separate from display, retrofittable
- Q-Logic: Blue Tooth
  - Built-into display
  - IR mouse also available



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Transmission Method

- Signal sent from the power wheelchair, typically the display
- A receiver is connected to the computer
- Consumer must buy the receiver
  - Not Invacare

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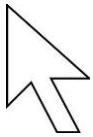
Cursor Movement

- Drive method is used to move the cursor on the computer screen
- Consumer has to change "modes" from Driving to mouse emulation
- Proportional access
- Digital access



Pros and Cons

- Pros
  - Streamlines access
  - Wireless, increases independence
  - Cost savings
- Cons
  - May not be the optimal computer access method
  - Takes more refined control than driving

Cursor Movement

- Proportional access
  - 360 degree movement
  - The further the joystick is deflected, the faster the cursor will move

Cursor Movement

- Digital access
  - Directional switches move the corresponding direction
  - If three switch access is used (i.e. head array), Forward often moves the cursor up. The cursor wraps around to the bottom of the screen
  - Forward/Reverse and Left/Right can be combined to provide diagonal movement
  - One speed, set on the computer

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Clicks

- Click emulation
- Physical clicks

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Clicks

- Click emulation
  - Software (i.e. Dwell Click, www.sensorysoftware.com)
  - Cursor hovers over the desired selection
    - Left Click, Right Click, Double Click, Drag
  - The selection is executed when the cursor hovers over an item

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Physical Clicks

- Consumer has to be able to use an additional switch or be able to discriminate between quick hits and sustained contact to move the cursor

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Mouse Emulation

- Invacare Specifics:
  - Discovery
    - Plug in USB dongle
      - Flashes red
    - Plug switch into left mouse jack while turning on chair
      - Flashes green

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Mouse Emulation

- Invacare Specifics:
  - 3 or 4 quadrant control

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3 or 4 Quadrants?

- 4 Quadrant control
  - 4 quadrants of driver control operate the mouse in 4 directions
  - Typically used with joystick
- 3 Quadrant control
  - Forward toggles Mouse up, Mouse down (MK6i)
  - Forward is changed to reverse with external switch or back pad hit (R-Net, Q-Logic)
  - Typically used with Head Array

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Mouse Emulation

- Invacare Specifics:

  - 3 quadrant control:
    - R command = L/R
    - F command = Up/Down
    - L command = mouse click/double click/drag (or latch)
    - 4th quadrant can be R click
  - Clicks
    - 2 switch jacks on mouse module for L/R clicks
      - 1 switch: L click
      - 2 switches: L/R clicks

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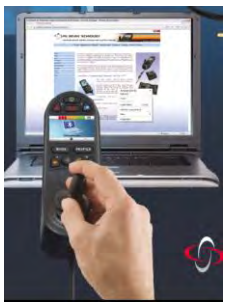
Mouse Emulation

- R-net Specifics:
  - 3 or 4 quadrant control

Mouse Module



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Mouse Emulation

- R-net Specifics:
  - Clicks:
    - Joystick
      - Speed Up and Speed Down buttons for L/R clicks in mouse mode
      - Any quick hit of a directional command can be programmed as L or R click or Scroll Up or Scroll Down
    - Alternative Access
      - Any quick hit of a directional command can be programmed as L or R click or Scroll Up or Scroll Down

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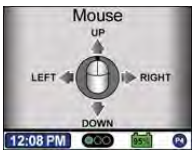
Mouse Emulation



- Q-Logic Specifics
  - 3 or 4 quadrant control
  - BT must be paired to PC
  - Mouse Emulation takes up one drive profile
  - Reset switch required for some functions
  - Programming
    - Mouse speed: slow, medium, fast (Scaling)

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Mouse Emulation

- Q-Logic Specifics
  - Clicks, method #1:
    - L quick hit = L click
    - L double hit = double click
    - R quick hit = R click

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Mouse Emulation

- Q-Logic Specifics
  - Clicks, method #2:
    - Base Toggle
    - One switch toggles between mouse movement and mouse click
    - Mouse click screen displays options for each directional movement: L click, R click, double click and drag
    - Base Auto
      - Automatically returns to mouse move after any click

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Mouse Emulation

- Q-Logic Specifics
  - Clicks, method #3:
    - Add external switches
    - External cable required
    - L/R clicks

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Keyboard Emulation

- On-screen keyboards
- Requires precise cursor control
- Dwell or Click

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Interfacing External Mouse Emulators

- Accessing other assistive technology through the drive method
  - External mouse emulators
- Components required for interfacing
  - Interfacing component
  - Interfacing cable

M. Lang

Interfacing External Mouse Emulators

- Wired (ASL 519)
- Wireless
  - Zigbee signals
- Switch for Left, Right and Center
- Can control more than one device
  - i.e. computer, SGD

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Interfacing External Mouse Emulators

- ASL 554
  - 3 or 5 switch configuration
- 3 switch
  - R switch: moves cursor right and left
  - F switch: moves mouse up and down
  - L switch: left click, double click, drag

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Interfacing External Mouse Emulators

- ASL 554
  - 3 or 5 switch configuration
- 5 switch
  - Joystick acts like a joystick operated mouse
  - Separate switch for L click and drag

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Interfacing External Mouse Emulators

- Switch-It! Mouse Driver
- 3 to 5 switch control
- Proportional access methods
- Radio transmission

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External Mouse Emulators

- Magitek Mouse Mover
  - Proportional
  - "Magi-Mouse" Mouse Mover

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External Mouse Emulators

- Dynamic Controls
  - I-Portal Mouse Mover
    - Compatible with DX Electronics
    - MK6i compatibility in 2013

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Switching Modes

- How is the client going to get from driving to mouse emulation and back?

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Video Time!

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Resources

- ASL has a terrific series of step-by-step instructions for mouse emulation on each electronics package!
  - Ask for copies!
  - http://www.asl-inc.com/technical-support/programming-documents.php

Questions?

Demonstration Time!

Cutting Edge Time (CET)!

EMERGING TECHNOLOGIES

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Tablets, Cell Phones, MP3s, Oh My!

- Tablets
- Cell Phones
- MP3 players

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Tablets

- Can I control my tablet from the PWC drive method?
  - Yes and No…

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PC based Tablets

- PC Tablets (Android platform 3.1 and above) support an external mouse
  - Invacare
    - Requires mini USB to USB cable
    - Dongle plugs into this
  - Q-Logic and R-Net
    - Recognizes as BT mouse
- iPads do not recognize mice…yet

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PC based Tablets

- The joystick or other access method can then act as a mouse (using mouse emulation)
- An external mouse click is required
- Keyboard
  - Click on keyboard icon in lower right corner
    - Physical keyboard switch to "off"
    - Keyboard will show up when text field is selected
- Tablet has to stay awake
  - "Stay Awake" App

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Tablet Access

- Invacare has a great video on accessing a PC Tablet using Mouse Emulation on YouTube
- Check it out!
- You Rock Babinec!

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iPortal2

- Dynamic Controls
  - I-Portal Mouse Mover + Accessibility
    - Compatible with DX Electronics
    - MK6i compatibility in 2013
    - Mouse emulation
    - Control of cell phones, tablets

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Tablets – Switch Access

- There a more and more switch interfaces coming out, but let's look at 3:
  - APPlicator
  - Tecla Shield
  - Hook

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APPlicator

- Provides switch access to iPhones, iPods, iPads
- Switch access to Apps (switch accessible) and Music
- Can choose what command is sent when switch is activated
  - i.e. Volume Down takes a picture in camera mode!
- Inclusive TLC

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Tecla Shield

- Komodo Open Lab
  - http://komodoopenlab.com/tecla/
  - BT, pairs with smartphone or tablet (and iPod Touch)
  - Works with Android and iOS
  - Single and dual switch

Auto-scanning

  - 3 switch step scanning
  - Uses VoiceOver
  - Connects to Interfacing Component

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Tecla Shield

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Hook

- AbleNet
- Provides switch scanning with auditory (speech) cues
- Allows client to move through music or audiobooks on most smartphones or tablets
- Wired connection

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Smartphones

- R-Net
  - HouseMate 5 Switch
  - ClickToPhone software
  - Android smartphone
  - Five switch or joystick input
  - Requires
    - R-Net IOM
    - HouseMate R-net Interface cable

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Smartphones

- http://www.click2go.ie/blog/housemate-wheelchair-interfacing/

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Game Time!

- ASL 403 Play Station modification
- Can operate Playstation 2 through drive control
- 12 mono ports
- Requires Interfacing Component

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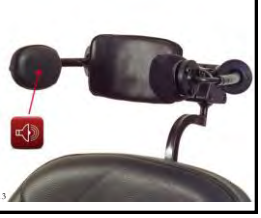
Speakers

- Add speaker in headrest
  - For auditory scanning on Speech Generating Device
  - For auditory input from technology including MP3 players, tablets, etc.
    - Music
    - Audio from video files
    - Audiobooks



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I Need the Power!

- We use so much technology these days that needs charging!
  - SGDs
  - Tablets
  - Cell phones

ASL 509

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Technologies to Help Driving

- Monitoring
- Sensors
- Emergency Stops
- Attendant Control

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Monitoring

- iPortal Dashboard App
  - Displays real time information about the wheelchair on a Smartphone
    - Speed
    - Compass
    - Seat angle
    - Battery state
    - Emergency contact
    - diagnostics

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Sensors

- Many clients with low vision or poor attention could benefit from a clue that they are too close to obstacles
- Photo electric sensors
- 4 – 21" range
- Up to 4 switches and 2 tones

ASL 404

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Remote Emergency Stop Switch

- Great for training
- Also helpful for safety if client loses attention or does not see a potential obstacle

Switch-It!

ASL

M.

Attendant Control

- Many clients tire and need someone to take over
- The client's access method may not be driveable for others!
- Wireless options

ASL

Wireless Options

- For interfaced AT
- For the Reset switch

Lose the Wires!

- Interfacing external AT devices often requires an interfacing cable dangling between the device and the rear of the PWC
  - Wireless options
    - ASL Wireless Switch Transmitter and Receiver
    - AbleNet JellyBeamer
    - AMDI

Reset Switch Options

- Invacare requires the Reset switch to be plugged into the display, leaving a cord in the way
- This product plugs into the main electronics to allow the reset to plug into the back

ASL 528

And Other Misc. Cool Stuff!

Seat Function Scanners

- Switch-It! seat function scanner allows 1-2 switch control of power seating
- If someone only had 2 switch locations, 1 could be for single switch scanning for driving and 1 for scanning multiple seating options

Power Tray

- Motion Concepts
- May facilitate independent transfers

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Alert or Loud Horn?

- Attendant Alert is activated by a single switch and beeps while the switch is depressed
- Could also use as a louder “horn” or an accessible horn
- Can interface

ASL 522

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Electronics Protection

- After setting up all these Advanced Electronics, the back of the PWC can look like a spaghetti factory!
  - Protection from dust/dirt
  - Protection from moisture
  - Protection from prying hands!

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Display Mounts

- Typical display mounts can be bulky, in the way and not maintain their position
- Newer options are more streamlined, can swing out of the way (yet go back to a identified position) and maintain that position

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Leg Bag Emptiers

- Allows the client to empty on their own through the drive control
- Drive over a bathroom drain or grassy area

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Questions?

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The Future is out there…

- These younglings at MIT are doing incredible work!
  - Something to be said for being born after this stuff was invented

Take Home Message:

- There are many ways to drive a power wheelchair!
- Programming optimizes driving for an individual
- Interfacing allows multiple devices to be controlled by one access method
- IR transmission can provide increased independence in the home environment
- Mouse emulation can provide computer access through the power wheelchair

Thank You!

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Advanced Power Wheelchair Applications
Programming Worksheet

1. Get in a group and go to the Exhibit Hall
2. Go to a booth with Power Wheelchairs (they should be expecting you!)
3. Grab a programmer and some help, if you need it
4. Change each of the following parameters and drive!

All done? Try this again with another manufacturer's electronics!

You may have to exaggerate your settings to see the difference

Basic Driving Parameters (use a joystick):

___ Forward Speed

___ Turning Speed

___ Acceleration

___ Deceleration

___ Sensitivity

___ Short Throw

___ Changing Axes

Access Method Specific Parameters

___ Try various options to access reverse when using a Head Array

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
Power Wheelchair Bases supported	TDX series, FDX, Storm Series, Power Tiger, Some Pronto models	All Permobil bases Quickie Redman, other manufacturers	All Quantum Some Jazzy
Tracking technology	True Track: (GB Motors) G-Trac™ (Gyro Module) available on all MK6 systems . G-Trac can be enabled or disabled in any individual drive profile	Works with Permobil: ESP	Accu-Trac Technology
Electronics upgrades	Insert upgraded Pro (SD) Memory card into driver control – follow prompts. (Software upgrades available from web)	'Future Proofing' feature (new modules can be added without programming). Some modules are 'flash' upgradeable	Yes, software download by computer or hand held programmer (Software upgrades available from web)
Initial system set-up	Factory settings. Programmer or SD card to modify for user needs. All modules added are recognized automatically – some (IR / Mouse) require initial programming	Plug and Play, modules recognized and programmed automatically	Plug and Play, modules recognized and programmed automatically
Programming			
Separate hand held programmer	Yes Help/Info key provides assistance. MK6 Hand Held Programmer (HHP) works on MK5 and MK6 systems. SD card available to back up or store commonly used programs.	Yes DTT – includes USB memory stick option for transferring files, mini-USB port for connection to PC.	Yes Programmer compatible with NE (non-expandable), NE+, and Q-Logic electronics. Help key to describe parameter functions. Internal 64mb memory & SD card available for additional memory storage.
HHP revision independent	Yes	Yes	No, upgrades available on web.
Program through display (manual buttons)	Yes, with SD card, can see all 4 drives at once on display	Yes	Limited
Program through joystick display	Yes, w/ SD card on all expandable systems – views one drive at a time.	Yes. On Board Programming Can see 4 Profiles at once	Limited
Consumer can program through access method	Yes, with Professional SD card IR programming w/ Pro or basic card IVC recommends only qualified individuals change programming settings on the power chair.	Yes Two access methods – keycode or 'dongle'. OEM sets which.	Limited- 24 hour time clock, language, trip odometer reset, reminders
Can program through computer	Yes, indirectly via Professional SD card	Yes PC Programming Tool	Yes PC Programming Station
Memory backup	Yes, onto Basic or Pro SD Card. (Non computer dependent) Card data can be read using USB card reader to view settings on PC.	Yes Through computer	Yes Through computer or handheld programmer. Programs can be shared between two with SD

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	PG Drive Technology R-net	Quantum Q-Logic
			card or through USB plug-in.
Can do "real time" programming	Yes on Non-expandable SPJ+ Joy. No on Expandable systems. (Programmer can remain plugged in, but turned off when driving)	Yes	Yes
Diagnostics	Time and Date stamped error codes available on programmer of color displays w/o use of programmer. Error Code Help Screens .(Def. & action required for remediation) Additional diagnostics for actuators and driver controls. Battery and connected device diagnostics viewable on color display screens	Each module has its own error log. Faults recorded sequentially for ease of use when diagnosing intermittent faults	Through computer and handheld: includes descriptions and error code help screens. Time and Date Stamp on fault codes. Help key will aid in diagnostics by providing possible causes of fault as well as steps to correct the error.
Monitoring	Actuator Amp draw & Angle Position with Smart Actuators Status of limit switches.	Can monitor system voltage, currents, inhibits etc. with both PC and DTT	Through computer and handheld programmer: 100+ items available to monitor including seat position, actuator run time, multiple motor parameters, switch and button status
Number of Drives/Profiles	4 (plus one for Attendant Control)	8	5 (5 for each drive control device), can eliminate any unneeded drives
Preset programs	Up to 13 available Standard driving programs, each can be modified, each can quickly be saved into any drive profile.	Single program of factory settings	Single program of factory settings for each device type. Additional programs available on web.
Simple vs. Advanced programming options	Can change Overall Speed and Response in each dive profile, or access all Programming adjustments	All levels of Programming accessibility are accommodated (Dealer/User/Therapist, Engineering/OEM and custom)	Simple as well as advanced programming for mode navigation.
Torque	Yes, programmable	Yes, programmable	Intuitive torque built-in (higher torque at lower speeds)
Sensitivity (how quickly the chair responds to joystick movement)	Tremor dampening settings as well as individual acceleration adjustments for forward, turning and reverse quadrants allow accommodation of user needs Traction parameter adjustment reduces speed when going into or coming out of a turn.	Tremor dampening Also separate Acceleration parameters for Forward, Reverse and Turn at minimum and maximum speeds in each profile	Turn Sensitivity parameter available to increase or decrease sensitivity. Speed turn rate parameter available to adjust sensitivity at higher speeds for steer correction. (all options per Drive) Tremor Suppression is global
Initial travel (distance) of the joystick is ignored	No	Deadband, programmable	Center Deadband, programmable

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
No Drive Mode (allows Driver to enter a Mode or Drive in which the chair will not drive)	Sleep mode (all functions disabled) Also "No Driving mode, disables driving in selected drive w/ all other programmable functions available	Sleep Mode	Rest profile can be programmed, no seating or drive functions available in this profile, mode command exits profile. Also Sleep mode
Program which drive to start in at Power On	Yes Program last drive used or a specific drive profile	Goes to last Profile used Power-up 'Mode' programmable on some JSMs	Yes Program to last drive used or specific profile
Display			
Color display	Yes, (Mini color Display)	Yes. Two contrast options – indoor or outdoor	Index Matching on displays to absorb ambient light for outdoor use, visor option available for enhanced display
Backlit display	Yes (Monochrome) Auto adjusts to ambient light	Yes	Yes, programmable dimming time and backlight. Programmer also has programmable backlight.
Languages supported	English	All text is programmable meaning all 'European' languages can be supported	English, German, Spanish, Italian, French
Customize text wording	Yes, with MK6i Programmer or Professional SD Card	Yes, through computer	Yes, through computer
Change font size	Enhanced View Mode enlarges Icons on Monochrome display. Enhanced & Sequential Scanning Modes with enlarged icons	Programmable option of large 'momentary' screens when changing speed or profile. Highlighted "User Menu" items are enlarged	No
Icons/Graphics	Yes, some combined with text	Yes, some with programmable text, e.g. mode names. Custom Icons are available to OEM's	Yes, profiles can be assigned as preset text, icons, or colors and shapes (pediatric).
Display required for alternative access method	No, can add to any system w/ expandable Joystick or display.	No, can use Input/Output Module (IOM) instead	Yes. Display and Alternative Inputs combined.
Buttons on Display	Monochrome: Info (help), Save, Select, Directional arrows. Color: Power, Mode, Drive Select	Profiles, Mode, Power, Speed Up, Speed Down, Horn	Power

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
Switch Jacks on Display	Two: 1 = Remote power on/off, 2 = mode port with up to 2 available functions using splitter or stereo switch	Two: Power and Profile / Mode	Two: 1 = Remote power on/off, 2 = mode port Mode- simple and advanced programming *Simple: cycles through modes* *Advanced:* *short command cycles through Drive Profiles* *long command toggles between Drive Profiles and Aux. & Seat functions* Power- on/off jack switch type feature can be programmed to accommodate up to 4 commands through one switch. *Power, mode, emergency stop, toggle (fwd / rev)*
Access to functions: consumer level of control	IVC recommends only qualified individuals change programming settings on the power chair. Consumer can add new IR devices by IVC Basic SD Card. Consumer can add new IR devices w/ Basic SD Card – and change date & time.	Consumer cannot program unless they have access to OBP Can disable speed buttons on joystick or display through programming Consumer has access to user menu to change clock time/settings, trip odometer, backlight color & display	Consumer can only change clock, trip odometer, profiles and speed. These can be restricted, as well.
Shortcut Menu on Display	No	Mode Selection in Standby. Any Mode or Profile can be entered via the joystick from Standby	Can program a "Quick Access List" of desired shortcuts that are shown when chair goes into auxiliary menu.
Locking feature to prevent any external access to chair	No	Yes: Either button sequence or key or both or neither – fully programmable	System Lock - can be turned on or off
Other	User can view battery voltage and date / time stamped error codes to report to RTS prior to service calls	Clock, speed display on color version Mode name and profile name text programmable	Can download digital photos to display or hand control Clock, MPH, Battery %, Trip Odometer, Odometer
Joystick: hand rest	Multiple Joystick Styles PSF style provides hand platform	No	Yes, through custom department.
Joystick: display	Yes, color MPJ or monochrome (PSF – PSR)	Yes, monochrome or color	Yes, color, index matching
Joystick: buttons or toggle switches	Various options including buttons, toggle and dials on some joysticks	Buttons, Toggles and / or speed pot optional	Buttons, side mounted dial (speed) and toggle (on/off, profile)

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	PG Drive Technology R-net	Quantum Q-Logic
Joystick: switch jacks	Two: 1 = Remote power on/off 2 = Stereo (two choice) switch port. (Can be programmed for Mode select, Drive Select, or Single actuator operation, (up, down, and up/down). May program two actuator functions to allow toggle switch function of actuator	2: power and profile / mode	Two: 1 = Remote power on/off, 2 = mode port Mode- simple and advanced programming *Simple: cycles through modes* *Advanced:* *short command cycles through Drive Profiles* *long command toggles between Drive Profiles and Aux. & Seat functions.* *Power- smart switch if enabled will changes profile with short commands and long commands will power unit off.*
Joystick: speed dial	Yes, option	Yes, option	Yes- can be programmed for: *Limited:* high and low limits *Continuous:* no limits *Continuous forward:* only forward movement of dial is required to change speed, will cycle through *Continuous rearward:* only reverse movement of dial is required to change speed, will cycle through
Joystick: shortcut buttons	No	Profile button can be reassigned to provide access to both profiles and modes	2 – 1 for profile 1 and 1 for seat profile- Labeled I and II Menu button displays Menu of shortcuts on display for user programming.
Joystick: Can program the same joystick to be proportional or switched	No-Except if using latched driving. (latched mode with joystick operates in digital or switch mode)	No (Step latched drive operates in digital manner)	Yes, if joystick is deflected more than 50% will act as switched joystick when programmed
Joystick: can use with only 3 directions	Yes, activate RIM Mode Enter "Reversing" mode either w/ mode switch or through "Standby Select"	Training Mode allows one or more drive directions to be inhibited	Yes, 3-Direction Profile, using Left, Right and Reverse Forward/Reverse toggle accomplished by quick movement in Reverse Double hit to left to access actuators
Joystick: compact/remote joystick	Yes, no buttons (Several additional ASL compact remote choices as well)	Yes, Compact Joystick & Compact Joystick Lite (via Omni or IOM) with optional ability switch attachments	Stand Alone joystick Power and Mode buttons 3 Drive & Actuator Functions

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
Component required for alternative access connection	-Digital Interface for Sip n Puff & digital driver controls. -Interface for ASL digital systems. -No Interface required for Alternative Proportional Controls.	Omni Display (2 9 pin ports) or IOM (9 pin port)	Enhanced Display (9 pin) and Sip and Puff Interface
Number of alt. input devices that can be connected	Up to 4 Driver Controls plus attendant control.	2 (on each Omni) 1 (IOM) System can support up to 14 Omnis with 2 access methods each	Up to 4 driver controls- 1 Joystick, 1 Stand Alone, 1 Attendant Control, and 1 Specialty Control
Transfer of control between alternative input devices	Choose Drive Profile with desired driver control selected/assigned	Choose Profile programmed with that access method	Turn on the input device using power button for that device (i.e. on display)
Head Array	Access to Reverse options: 2 options: 1. Mode switch: 1st activation enables Reverse. 2nd activation returns to forward driving. 2. Bypass mode switch by programming "Standby Select". Once in Standby, left driver command activates Reverse driving. Forward command activates Forward driving.	Access to Reverse options: *Mode switch:* single operation toggles direction Or *Rear Pad:* first activation toggles direction, second activation drives 'Switch Medium' time for easy access to user menu 2 axis option for seating actuator control	Access to Reverse options: *Mode switch:* 1st activation chooses Reverse, second activation can be either mode or standby select Or *Rear Pad:* first activation toggles direction, second activation drives
Sip 'n puff	4 pressure Digital Interface Pressure programmable in all 4 quadrants to match user's abilities	4 pressure Built into Omni display Programmable 'ramp up', 'ramp down' time	2 or 4 pressure option Separate module required Can adjust Sampling Delay to allow consumer to "ramp up" to command Visual and audible pressure meter on client's display screen.
Switch Access	Supports single, 3, 4 and 5 switch access Can do 2 switch access using ASL 2 switch fiberoptic array	Supports single, 3, 4 and 5 switch access Can do 2 switch access using ASL 2 switch fiberoptic array	Supports single, 2, 3, 4 and 5 switch access <u>2 switch:</u> 1st switch – double click and hold is Forward, single activation is Left. Double click and release is Mode. 2nd switch – double click and hold is Reverse, single activation is Right Can also do 2 switch access using ASL 2 switch fiberoptic array <u>3 switch:</u> Double hit on left to access actuators

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	PG Drive Technology R-net	Quantum Q-Logic
Single switch scanning	Requires external scanner	4 directions on display Can scan all chair functions	12 scanner options: single or 2 stage options. Scanners can be programmed to specific profiles or be global. Mode option can be disabled when scanning for communication devices.
Power button/toggle on joystick	Yes	Yes	Yes, push toggle forward for on or rearward for off, each subsequent push forward goes through profiles
Power switch jack on joystick	Yes	Yes	Yes
Mode button/toggle on joystick	Yes	Yes	Yes (same toggle as power)
Mode switch jack on joystick	Yes, (Stereo). Can add splitter for 2 functions. Program for Mode & Emergency, Stop, Drive Select, Single Actuator Operation. (May also use stereo switch).	Yes, can also access profiles Used as emergency stop in latched drive or switch to standby option	Yes, simple and advanced programming *Simple: cycles through modes* *Advanced:* *short command cycles through Drive Profiles* *long command toggles between Drive Profiles and Aux. & Seat functions*
Mode switch sequence: joystick	Reverse, Automatic Positioning, Powered Seating Actuators, Drive Select, IR, Mouse, ECU 1/2, 3/4	Profiles, Actuators, Aux., Drive. Sequence programmable	Drive, Actuators, Aux. Profiles 1-5 individually programmable for Drive, Seat, Aux. Disabled, or Rest
Standby option: joystick	Standby Select: (programmable time) allows driver control to select next operating mode after chair enters Stand By using directional command (Driving, Actuators, ECU, Mouse, IR, Drive Select). Standby can be disabled in ECU and Mouse mode.	Yes, adjustable time or via mode jack socket switch Can enter all modes and profiles from Standby, programmable direction commands	Standby Select: go to Menu of Profiles Can individually enable for drive, seat, aux. (global) Scroll time programmable
Sleep Mode: joystick	Sleep: programmable time Mode switch required to awaken	Yes, programmable	Yes, programmable
Shortcut buttons: joystick	No	Profile button can be reassigned to provide access to both profiles and modes	3 buttons- profile 1, seat profile, and menu.
Separate switch for actuators: with joystick	Yes	Yes, via ICS Alternative Switch Box. Attach up to 8 custom programmable ability switches.	Yes
Power (Alt. Access)	Switch port for remote on/off Toggle on display	Switch jack on Omni Display Switch jack on IOM	Switch jack on Display, Combined mode and power options available through Smart Switch (1^{st} activation Power On, subsequent activations Mode, long hit Power Off)

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	PG Drive Technology R-net	Quantum Q-Logic
Mode (Alt. Access)	Switch jack on Joystick and Display, mode button on Joystick and Display	Switch jack on Omni Display	Switch jack on Display, Combined mode and power options available through Smart Switch
Mode switch functioning (Alt. Access)	Mode switch activation enters next available activated function (Reverse, Aux, Powered seating, etc.), and also acts as an emergency stop switch.	Mode switch activation takes consumer to Driver's Menu on display or can activate sequence	Mode switch activation sequence: Reverse, Profiles, Power. Can be programmed in multiple different ways.
Standby option (Alt. Access)	Standby Select Mode occurs after a programmable time elapses. Directional driver control command chooses function / active mode. Standby in ECU and Mouse Mode can be disabled.	Yes, adjustable time or switch to standby via mode jack plug Directional command chooses function.	Standby Select takes consumer to list on display after a programmable time elapses. Can be enabled for drive, seat, aux. individually. Directional command chooses next function.
Display function navigation: manual (Alt. Access)	Manual scroll: directional switches move through displayed choices Driver Control: right command can scroll through drives 1-4, mode switch selects available modes in each drive. Driver Control operates highlighted Mode. Drive Control Navigation (no switches) programmable.	Manual scroll: Forward command moves up displayed list, Reverse moves down, Right selects, Left moves back a level. Order of menu programmable.	Manual scroll: Forward command moves up displayed list, Reverse moves down, Right selects, Left moves back a level Holding down the Forward or Reverse command will continue to scan after a programmed amount of time
Display function navigation: scanning (Alt. Access)	3 scanning types - any drive command makes selection: Modified row column, enhanced (version of row/column w/large icons), sequential (one mode in each drive at a time). All with adjustable speed, adjustable initiation time.	Auto scroll: adjustable speed. Right selects and Left moves back a level.	Auto scroll: adjustable speed. Right selects and Left moves back a level.
Display function navigation: auditory scanning (speech) (Alt. Access)	No Auditory feedback available for screen/mode changes whether through manual operation or in scanning modes. Different beeps used for different modes. Allows Display to be non-visual dependent. (Can mount on back of chair).	No Auditory feedback to indicate Profile, operating Mode or selection on User Menu	No Different tones for each drive profile, seat, and auxiliary. Auditory feedback available for screen/mode changes whether through manual operation or in scanning modes
IR signal output	IR Module pending release, 6 devices (1 X10) Can interface external EADL with IR capabilities through Aux. modules	Yes, standard on Omni Can also interface external EADL or send IR through a computer accessed through the wheelchair.	Yes Back of Display, multidirectional
Preset codes	Yes	Yes	No

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	PG Drive Technology R-net	Quantum Q-Logic
Learning	Yes	Yes	Up to 288 (depending on size of code), macros (up to 3 commands)
Macros	No		Yes
X-10 control Insteon control	IR Module w/ X-10 capabilities 8 devices Can interface external EADL or send IR through a computer accessed through the wheelchair.	Yes, through IR/X10 converter or IR/Insteon converter Can interface external EADL or send IR through a computer accessed through the wheelchair.	Yes, through IR/X10 converter or IR/Insteon converter. Requires IR remote for programming (not included) and modules (not included) Can interface external EADL or send IR through a computer accessed through the wheelchair.
Telephone	IR Module can access IR phone Can interface external switch operated phone or send IR through a computer accessed through the wheelchair.	IR receiving phone (not included) Can interface external switch operated phone or send IR through a computer accessed through the wheelchair.	Yes IR phone (not included) Can interface external switch operated phone or send IR through a computer accessed through the wheelchair.
Mouse emulation	-Yes, separate from display -Can retrofit -Radio Frequency (RF) -Proportional with joystick 3 or 4 quadrant operation 3 quadrant Operation: Rt command = L/R, Fwd command = Up/Down, L command = mouse L click, /double click/drag. R command can be R click $995 (mouse and IR pkg) $795 Mouse Only	Yes, separate from display, optional Blue Tooth Mouse Module Proportional with joystick $300	Yes, built into display Blue Tooth or IR IR requires ASL or GEWA mouse receiver Proportional with joystick Harness to power module with 1-2 switch jacks

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
Mouse emulation Clicks	2 switch jacks on mouse module for left and right clicks Or Use dwell software Or Use 3 quadrant mode Left command = left click Reverse command = right click Forward	Joystick: can use Speed up and Speed down buttons for L/R clicks in Mouse Mode Joystick or Alt. Access: any quick hit of a directional command can be programmed to L or R click or Scroll up or down or Use dwell software	Left directional switch: click, double hit=double click Right directional switch: right click or one switch: toggles between mouse movement and mouse click. Mouse click screen: 4 directions for L click, R click, double click and drag or Use dwell software Programming option to make the clicks through the input device. Double left or Double right toggles between mouse movement and mouse clicks.
Auxiliary function templates	N/A	No	Yes, can customize
Component required for interfacing	Aux1/2 or Aux3/4 (can use both) Aux1/2 = 2 outputs, 4 switch closures each Aux3/4 = 2 outputs, 5 switch closures each	IOM: Input/Output Module	ECU Module, 8 switch outputs
Attendant Control	Proportional or Digital		
Attendant control features	Power w/c control, does not use up a drive profile Programmable Performance Adjustments for both Proportional & Digital Att Controls If attendant control is on, Driver access method will not operate.	Uses Profile 8 as standard Can be programmed to any profile(s) Programmable 'grab' option to allow either the caregiver or the user to regain control. Can access all user modes or programmable to specific modes	Power mode button Doesn't use up a profile If attendant control is on, access method will not operate. Profiles individually programmable. Profiles 2-3 can be turned off

Complex Rehab Power Wheelchair electronics
Comparison matrix

	Invacare MK 6i	**PG Drive Technology R-net**	**Quantum Q-Logic**
Actuators			
General comments	Smart actuator: can execute Automatic Positioning (from only 1 or up to 6 steps each sequence), up to 4 pre-set positions (1 per Drive). Automatic Positioning with tilt, recline, and center mount legs. Actuator Speeds programmable. Drive lock out programmable on / off	Up to 12 axes of seat motion can be defined using up to 6 actuators, either singly or in multiple combinations. Inhibits can be used to slow or stop chair or any actuator motion depending on position of an actuator. Programmable actuator speed Permobil: ICS Intelligent Control System (not R-net).	Up to 12 axes of seat motion can be defined using up to 6 actuators, either singly or in multiple combinations. Inhibits can be used to slow or stop chair or any actuator motion depending on position of an actuator. Programmable actuator speed, start and stop angles Joystick control allows proportional speed control.
Pressure Relief Signal	Series of beeps and a visual prompt to perform pressure relief. Chair will not drive until the mode switch is activated, (user acknowledges beeps). Frequency (time) is programmable up to 60 minutes.		Can program individualized reminder for pressure relief. Can program for set time or as an interval. Will repeat to programmable frequency until confirmed. Optional audible alert.
Other			
Other comments	Memory card works on Expandable level electronics only (4 Drive Systems). Can store/archive multiple systems or individual drives in a library for downloading to other systems. MK6 Laptop IVS can view / change / print programmed settings	3rd party additional modules available from HMC, others pending	User Reminder feature- programmable time or interval with customized wording programmed in PC programmer. Maintenance Reminder feature- programmed by days or miles. Can be individualized with PC programmer to input company name / number or other text.